



Farnell

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MI RANGE

MAINS INVERTER POWER SUPPLIES

The Farnell MI mains inverter power units are high efficiency - small size d.c. power supplies utilising the DOLS (direct off line switching) technique in which the bulky mains transformer and heatsinks of the conventional series regulator supply are eliminated.

This technique offers three important advantages - 1) greatly reduced size, 2) much less weight and 3) higher efficiency. Isolation is maintained by a small transformer in the inverter stage.

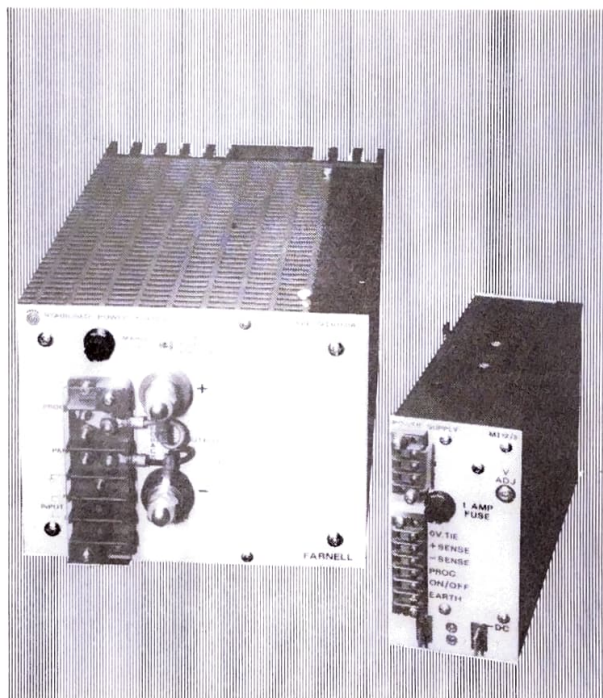
Voltage adjustment is provided by means of a trimmer potentiometer accessible through a hole in the front panel of the unit or is programmable by an external resistance.

Overcurrent and overvoltage protection are provided and are factory preset. The current limiting circuit automatically resets itself on removal of the overload. To reset the overvoltage crowbar circuit it is necessary to momentarily disconnect the mains input.

The units will operate at full load in ambient temperatures from 0°C to 55°C.

Provision is made for remote sensing of the load to correct for voltage drop in the load connecting leads. Units may be connected directly in series. Units may be connected in parallel as long as the crowbar interlink terminals are connected together.

Certain models also feature a remote on/off facility. Application of a 5V signal will disable the output.



Units available

MODEL	D.C. VOLTS ADJ.	MAX. CURRENT	PACKAGE	APPROX. SIZE	WEIGHT APPROX.
MI 6/60A	4 - 6 volts	60 amps	360 W	Height 127 mm	7.1 kg
MI 12/30	8 -12 volts	30 amps		Width 165 mm	
MI 24/15	16 -24 volts	15 amps		Depth 264 mm	
MI 6/40	4 - 6 volts	40 amps	240 W	Height 88 mm	2.5 kg
MI 12/20	8 -12 volts	20 amps		Width 160 mm	
MI 24/10	16 -24 volts	10 amps		Depth 170 mm	
MI 6/20	4 - 6 volts	20 amps	120 W	Height 110 mm	2.5 kg
MI 12/10	8 -12 volts	10 amps		Width 100 mm	
MI 24/5	16 -24 volts	5 amps		Depth 255 mm	
MI 6/10	4 - 6 volts	10 amps	60 W	Height 120 mm	1.8 kg
MI 12/5	8 -12 volts	5 amps		Width 63 mm	
				Depth 200 mm	

SPECIFICATION

MAINS INPUT	220/240V by tap changes. 45-400Hz. 60W units will operate from 198 to 265 volts and have no tap change
MAINS VARIATION TOLERATED	$\pm 10\%$
LINE REGULATION Output change for a $\pm 10\%$ mains change	$0.05\% + 5\text{mV}$
LOAD REGULATION Output change for a zero to full load change	$0.05\% + 5\text{mV}$
RIPPLE at full load ($\Delta f = 25\text{kHz}$)	Less than 30mV pk-pk
SPIKES ($\Delta f = 30\text{MHz}$)	Less than 100mV pk-pk
TEMPERATURE COEFFICIENT	0.01% per $^{\circ}\text{C}$, typical
OUTPUT IMPEDANCE	Less than 0.1Ω at 100kHz and 25°C , typical
TRANSIENT RECOVERY TIME	Less than 1mS for output to recover within 50mV following a 10% to full load change of $5\mu\text{S}$ risetime, typical
OPERATING AMBIENT TEMPERATURE RANGE at full output current	0 to 55°C
MAXIMUM OPERATING AMBIENT TEMPERATURE	70°C . Output derates linearly from full load at 55°C by 4% per $^{\circ}\text{C}$
STORAGE TEMPERATURE RANGE	-40°C to $+85^{\circ}\text{C}$
HOLD-UP TIME typical at midrange voltage setting, full load and mains at -10% of nominal	Output remains within specification for 10mS after mains failure
EFFICIENCY	75% (360W); 66% (120W); 60% (60W), typical
PROTECTION	Overload - constant current limiting set at $I_{\text{max}} + 5\%$ Overvoltage - set at max. output voltage $+ 20\%$. Disables control circuit and output falls to zero

INSTRUCTION BOOK

FOR

**MAINS INVERTER
POWER SUPPLIES**

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SCHEDULE OF EQUIPMENT

The unit has been carefully packed to prevent damage in transit. When removing the unit from the box, be sure that all parts and accessories are removed from the packing material.

The complete equipment comprises:-

- a) 1 off Mains Inverter power supply complete with metal mesh cover.
- b) 1 off Instruction book.

Note:- In the event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd., within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd., or an agent of this company.

INTRODUCTION

The Farnell MI mains inverter power units are high efficiency small size d.c. power supplies utilising the DOLS (direct off line switching) technique in which the bulky mains transformer and heatsinks, of the conventional series regulator supply are eliminated.

The available voltage and current ranges are shown in the specification. Voltage adjustment is provided by means of a trimmer potentiometer accessible through a hole in the front panel or is programmable by an external resistance.

Overcurrent and overvoltage protection are provided and are factory preset. On removal of the fault condition the overcurrent protection resets automatically. To reset the overvoltage trip it is necessary to momentarily disconnect the mains input.

The units will operate at full load ambient temperatures from 0°C to 55°C.

This book covers all models in the MI range. The circuit diagrams etc. in the rear flap are relevant only to the model supplied.

SPECIFICATION

MAINS INPUT

220/240V by tap changes. 45-400Hz
60W units will operate from 198-265Volts
No tap change

MAINS VARIATION TOLERATED

+10%

OUTPUT

Model	d.c. volts adj.	max. current	package	approx. size overall	weight approx.
MI 6/60A	4 - 6 volts	60 amps	360W	Height 127mm	7.1kg
MI 12/30	8 -12 volts	30 amps		Width 165mm	
MI 24/15	16-24 volts	15 amps		Depth 264mm	
MI 6/20	4 - 6 volts	20 amps	120W	Height 110mm	
MI 12/10	8 -12 volts	10 amps		Width 100mm	
MI 24/5	16-24 volts	5 amps		Depth 255mm	
MI 6/10	4 - 6 volts	10 amps	60W	Height 120mm	1.8kg
MI 12/5	8 -12 volts	5 amps		Width 63mm Depth 200mm	

LINE REGULATION

Output change for a +10% mains change

0.05% + 5mV

LOAD REGULATION

Output change for a zero to full load change

0.05% + 5mV

RIPPLE at full load
($\Delta f = 25\text{kHz}$)

Less than 30mV pk-pk

SPIKES

($\Delta f = 30\text{MHz}$)

Less than 100mV pk-pk

TEMPERATURE COEFFICIENT, typical

0.01%/°C

OUTPUT IMPEDANCE, typical

Less than 0.1 Ω at 100kHz and 25°C

TRANSIENT RECOVERY TIME, typical

Less than 1mS for output to recover within 50mV following a 10% to full load change of 5 μ S rise time.

OPERATING AMBIENT TEMPERATURE RANGE
at full output current

0 to 55°C

MAXIMUM OPERATING AMBIENT TEMPERATURE

70°C. Output derates linearly from full load at 55°C by 4% per °C.

STORAGE TEMPERATURE RANGE

-40°C to +85°C

HOLD-UP TIME, typical at midrange voltage setting, full load and mains at -10% of nominal

Output remains within specification for 10mS after mains failure

EFFICIENCY, typical

75% (360W); 66% (120W); 60% (60W)

PROTECTION

Overload - constant current limiting set at full load current +5%.
Overvoltage - set at maximum output voltage +20%. Disables control circuit and output falls to zero

OPERATING INSTRUCTIONS

Installation

The units are normally supplied set for use with a.c. mains supplies of 240V nominal but may be specified set for a nominal input of 220V. 60W units have no tap change and operate from 198 to 265V inputs.

Check that the unit supplied is suitable for the local mains supply. Unless there is a label on the rear heat-sink to the contrary, the unit is set for 240V operation.

The unit is intended for use in an environment where ambient temperatures are between 0°C and 55°C.

Because cooling is by air convection, provision should be made to allow free air flow around and through the unit. Ventilation holes should be provided in the mounting plate or alternatively the unit should be vertically spaced off an un-ventilated plate by at least 15mm.

Operating instructions

Mains input leads should be attached to the front panel terminal block as follows:-

Live (Brown) _ _ _ _ _ to terminal marked 'L'
Neutral (Blue) _ _ _ _ _ to terminal marked 'N'
Earth (Green/Yellow) _ _ _ _ _ to terminal marked with earth symbol.

The unit may be used with its control circuitry sensing either at the output terminals or sensing at the load end of the connecting leads. Choice of method will be dictated by the amount of current to be drawn and the distance between the power unit and the load. Selection depends on the connection method employed.

Local sensing

Units are supplied connected for this mode of operation with links fitted between the 'OUTPUT +' terminal and the 'FEEDBACK +' ('SENSE +') terminal, and also similarly between the 'OUTPUT -' terminal and the 'FEEDBACK -' ('SENSE -') terminal. 'PROG', the programme terminal, is also strapped to the 'FEEDBACK +' ('SENSE +') terminal. The terminals are strapped by links fitted at the factory.

The d.c. output connections for the load are made via cable of suitable rating, to the large terminals marked 'OUTPUT-' and 'OUTPUT+'.

Remote sensing

This mode of operation is used to correct for voltage drop in the load connecting leads. The maximum voltage drop which can be tolerated depends on the voltage required at the load (V LOAD). If V LOAD is less than (VMAX - 1) volts then the total connecting lead voltage drop can be up to 1 volt. If V LOAD is greater than (VMAX - 1) volts then the total connecting lead voltage drop should be less than (VMAX - V LOAD) volts. The total voltage drop in the load connecting leads is the sum of the voltage drops in both the positive and negative load connecting leads. VMAX is the maximum specified output voltage for the unit concerned.

Connections are made as follows. Remove the sensing links between the positive and negative 'OUTPUT' and 'FEEDBACK' ('SENSE') terminals leaving in place the short link between the 'PROG', programme terminal and the 'FEEDBACK +' ('SENSE +') terminal.

The d.c. output connections for the load are made, as with local sensing, to the large terminals marked 'OUTPUT - and +'. Additional leads (which will carry only a few milliamps current) are connected, one from the positive connection at the load end back to the 'FEEDBACK +' ('SENSE +') terminal on the unit, and the other from the negative connection at the load end and back to the 'FEEDBACK -' ('SENSE -') terminal.

If possible the +ve feedback (sense) lead should be twisted around the +ve output lead and the negative feedback (sense) lead twisted around the negative output lead. Because of the additional inductance introduced in the remote sensing mode, the transient performance may be adversely affected. This may be improved by the addition of a capacitor, of the same value as the output capacitor within the unit, at the load end of the output leads.

NOTE:- Care must be taken not to draw load current from the feedback (sense) terminals.

Output voltage adjustment

The unit's output voltage is adjusted by means of the trimmer potentiometer accessible through a hole in the front panel marked 'SET OUTPUT VOLTAGE' (360W and 120W packages) or 'VADJ' (60W units). The trimmer may be adjusted with a small screwdriver to vary the d.c. voltage output over the specified output range of the unit.

External programming

Resistive programming of the supply is possible by introducing external resistance between the 'FEEDBACK +' ('SENSE +') and the 'PROG' programme terminal. The unit will provide full output current only over the specified output voltage range.

Procedure:- Add resistor between the 'FEEDBACK+' ('SENSE+') and the 'PROG' terminals, of value $\left[\frac{V_o}{2} - R_{14} \right] \text{ k}\Omega$

Set output voltage to required level by means of the 'SET OUTPUT VOLTAGE' potentiometer on the front panel. Once this has been set, the programming constant of the supply becomes $0.5\text{k}\Omega$ per volt. 'Vo' is equal to output voltage. R_{14} is in $\text{k}\Omega$.

Series and parallel operation

Units may be connected directly in series. Units may be connected in parallel as long as the 'PAR' (360W, 120W units) ('O/V TIE' 60W units) terminals of each unit are connected together.

Note:- damage may result if the 'PAR' (O/V TIE) Terminal is used for any other purpose than that specified above.

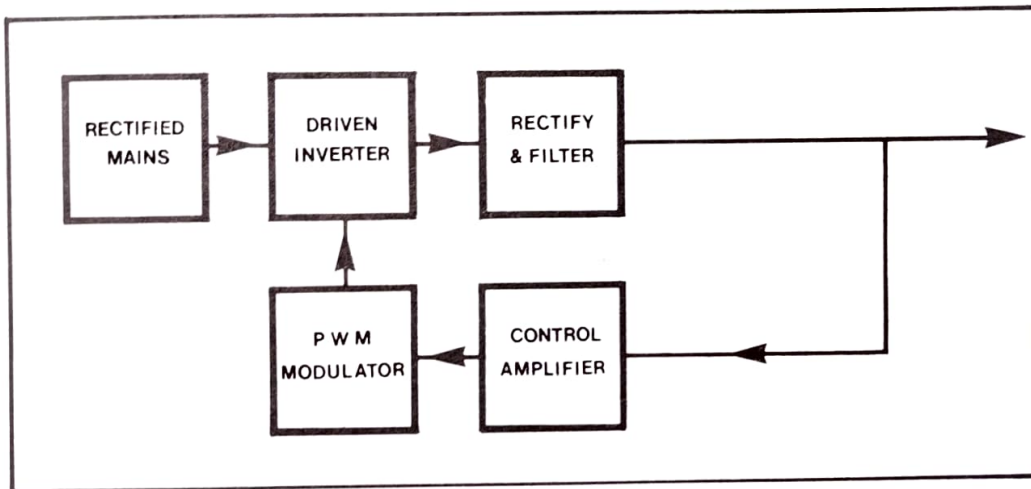
Remote on/off

The output of units fitted with 'ON/OFF' terminals may be disabled by application of a 5 volt signal between 'FEEDBACK-' ('SENSE -') and the ON/OFF terminal, positive to the ON/OFF terminal.

NOTE:- damage may result from excessive current applied to this terminal the drive source should be limited to 50mA.

THEORY OF OPERATION

The a.c. mains input is full wave rectified to provide a d.c. line of about 350V. This is applied to a d.c. to a.c. inverter circuit driven at a constant p.r.f. but in which the switch-on time (or duty cycle) of the inverter bridge transistors is adjusted via a controlling element. The p.r.f. of the inverter circuit is approximately 20 kHz. The output of the inverter is rectified and fed to the output L.C. filter and then to the output terminals as a regulated d.c. output.



Control is achieved by comparing the voltage output at the terminals with an internal reference and varying the mark/space ratio of the variable pulse width modulator which drives the inverter. As a change in output is detected the subsequent variation in mark/space ratio changes the duty cycle of the inverter transistors and thus the charge period of the output capacitor and hence makes a compensating change to the output voltage. A change of load current is acceptable within limits because of the change in reflected output impedance of the inverter bridge. For instance, if the load current increases, then the reflected impedance increases and more current is drawn from the supply during the duty cycle period and output voltage is maintained. If the output voltage should try to rise beyond safe limits then an overvoltage protection circuit operates which disables the control circuit and reduces the output voltage to zero.

MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd., is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In case of material or components employed in the equipment but not manufactured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparent circuit malfunction, it is advisable to telephone (or telex) the Service Department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs it is recommended that the complete unit be returned to:-

The Service Department,
Farnell Instruments Ltd.,
Sandbeck Way,
Wetherby, Yorkshire.
LS22 4DH

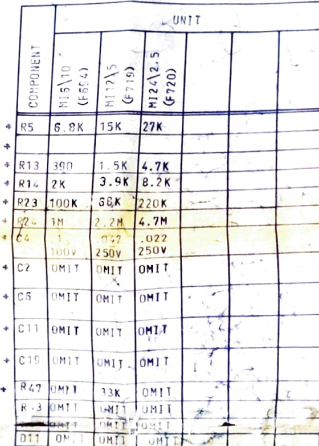
or

Service Depot,
Farnell Instruments Ltd.,
Hermitage Road,
London N4.

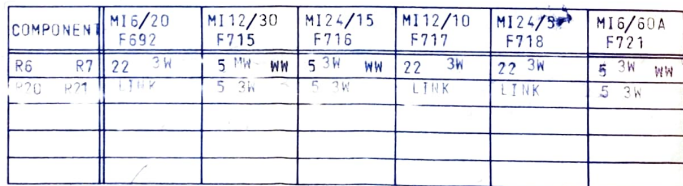
Tel: 0937 3541 Telex: 557294

Tel: 01-802 5359

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.



FARNELL INSTRUMENTS LTD.		WETHERBY, YORKS.
TITLE: CIRCUIT DIAGRAM		DRAWING No.
CONTROL BOARD	60N UNITS	? S2X 0019

F721

TRACED										
		D	15-8-74	Q 3125						
CHECKED		C	18-7-74	Q 3042						
		B	1-5-74	Q2887						
DRAWN	D. W.	ISS.	DATE	MOD. No.						
		A	23-2-73							

NOTE :—
CAPACITOR VALUES GIVEN IN μ F.
RESISTOR VALUES IN Ω
(2) REFERS TO C₁, BD,
PIN CONNECTION ON Nos.

FARNELL INSTRUMENTS LTD. WETHERBY, YORKS.

CIRCUIT DIAGRAM

DRIVE BOARD

120W AND 360W UNITS.

DRAWING No.

3 SZX 0018

